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Does Method Matter? A Meta-Analysis of the Effects of Training Method on Older Learner Training Performance

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Training the older learner has been the topic of considerable discussion but there is no consensus on which instructional methods are associated with higher observed training performance. We use random factors meta-analysis to explore the effects of three instructional methods (lecture, modeling, and active participation) and four instructional factors (materials, feedback, pacing, and group size) on observed training performance. The results reveal that all three instructional methods and two instructional factors, self-pacing and group size, explain unique variance in observed training performance. Self-pacing explained the greatest proportion of the observed variance. Implications of these results are discussed.

Over 40 million Americans age 40 and older are actively participating in the workforce. This represents an increase of more than 30% since 1990 and labor force projections indicate the number will rise to nearly 70 million by 2015 (Fullerton, 1999). Presently, 35 million workers are between the ages 45 and 54, 18.8 million are between the ages 55 and 64, 3.3 million are between ages 65 and 74 and nearly a million are over age 75 (Lerman & Schmidt, 1999; The U.S. Bureau of Labor Statistics, 2002). The number of people over age 65 participating in the workforce is expected to increase to 39 million by 2010 and 70 million by 2030 (Wellner, 2002). These projections indicate that a great many people will work past

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the traditional age of retirement. Thus, training older learners will become a fundamental component of organizational effectiveness over the next three decades. Organizations that learn how to train older workers effectively could stand to gain a significant competitive advantage over those that ignore these demographic trends.

The aging of the workforce challenges employers with keeping older adults abreast of emerging information and rapidly changing technology. Several physical and cognitive aspects of the aging process have important implications for training older learners, particularly older learners over age 60. For example, cognitive response times slow with age (Birren & Fisher, 1995). The decrement is slight for simple tasks but increases monotonically as task complexity increases (Spirduso & MacRae, 1990). Age-related declines also appear for certain components of memory. Research has shown that attentional deficits result in inadequate registration of instructional materials (Hayslip & Kennelly, 1985; Light, 1991; Park, 1994). Thus, older learners will have greater difficulty attending to training content.

Many have argued that older learners require different instructional methods relative to younger adult learners. Industrial psychologists argue that many aspects of the training program need to be modified to account for the unique needs of older learners (Glass, 1994). Accordingly, training models that account for these differences have been developed. For example, the industrial gerontology model suggests that five factors must be considered when designing training programs for older learners (Belbin & Belbin, 1972; Houle, 1961; Lindeman, 1926; Sterns & Doverspike, 1987); they are motivation, structure, familiarity, organization, and time. In general, these factors refer to issues such as: (a) whether the learner perceives the training content and materials as relevant; (b) whether sufficient time is provided to complete the training successfully; (c) whether the information is presented in a logical difficulty-graded sequence, i.e., from simple to complex; (d) whether the opportunity to master all training tasks is provided; (e) whether the training builds on current knowledge base; and (f) whether memory building instruction precedes content instruction (Belbin & Belbin, 1972; Hayslip & Kennelly, 1985; Sterns & Doverspike, 1987). Although potentially important for all learners, these five factors have been identified as particularly germane for older learners because the factors acknowledge important physical and cognitive aging effects related to learning (Sterns & Doverspike, 1987).

Similarly, Knowles (1990) calls for the development of learning theory for adult learners. He observes that theories of training and learning have been derived primarily from the study of animals and children. The word ‘pedagogy’ literally means the art and science of teaching children. He notes that pedagogy is based on the assumptions that learners: (1) need to learn what is taught if they wish to pass; (2) are dependent on the teacher; (3) tend to put more emphasis on the life experience of the teacher rather than their own; (4) have a subject matter orientation; and (5) are extrinsically motivated (i.e., grades, parental approval). Thus, traditional training methods (i.e., the lecture method) were developed based on these assumptions.

Knowles proposes an alternative concept, ‘andragogy,’ the art and science of teaching adults. He specifies several contrasting assumptions unique to adult learners. These fundamental assumptions are that adult learners have a self-concept of being responsible, have amassed considerable experience, are task or problem-centered, and need to know why they must learn something before undertaking learning it. Although not explicitly stated,

andragogy seems to suggest a shift from passive learning (pedagogy) to a more problem-centered, self-discovery approach to learning. While not universally accepted, the concept of andragogy provides a useful framework for understanding adult learning (Hayslip & Kennelly, 1985).

In response to the different requirements for the older learners, several instructional methods have been developed to address their unique needs (Belbin & Belbin, 1972; Elias, Elias, Robbins & Gage, 1987; Hayslip & Kennelly, 1985; Knowles, 1990; Sheppard, 1970; Sterns, 1986). The empirical research has focused primarily on the usefulness of these methods in reducing the gap between older and younger adult learners' training performance (e.g., Belbin & Belbin, 1972; Sterns & Doverspike, 1989). What has not been examined is whether, relative to training based on pedagogical principles, training based on andragogical principles explains more observed variance in older learner observed training performance. In this research, we move away from a "closing the gap" focus and instead seek to determine the effect of instructional methods and instructional factors on older adult learner training performance.

This shift in focus is essential for several reasons: (1) the growing number of people working beyond traditional retirement age; (2) older learners demonstrate a number of desirable work-related behaviors (e.g., lower turnover, absenteeism, and low accident rates); (3) with an up-to-date skill set, this employee represents a substantial resource to the employer; and (4) rapidly changing technology necessitates learning new knowledge, skills, and abilities to perform most jobs.

Past research highlights several aspects of instructional programs that have implications for the older learner. In the following section we present a review of this literature. Specifically, we address three instructional methods (lecture method, modeling and active participation in the focal task) and four instructional factors (materials, self-pacing, feedback, and group size).

Instructional Methods

For decades, three instructional methods have dominated the training literature: lecture, modeling and active participation in the training process. Several variations of each have been developed (e.g., videotape lecture, video modeling, discovery training, and role play); yet, the preponderance of training research pedagogy can be categorized into one of these methods (Carroll, Paine & Ivancevich, 1972).

Lecture

In its purest form, the lecture method involves a unidirectional flow of information—transmission from instructors to learners. Although the lecture method is physically passive, learning can only occur when participants are cognitively active. This method was developed based on the pedagogical assumption of dependency. During the learning process, learners rely primarily on the knowledge and experience of the instructor and, to a lesser extent, draw upon relevant personal knowledge and experience to make the material meaningful. The lecture method can be an efficient and effective method of knowledge transfer. It

is particularly well suited for transmitting information for immediate recall (Verner & Dickenson, 1967).

For older learners, the utility of the lecture method begins to diminish when lectures last more than 30 minutes or when learners lack relevant experience or sufficient prior knowledge to create personal meaning from the material (Pascual-Leone & Irwin, 1998). Furthermore, the lecture method places the cognitive burden on the learner. Learners are expected to attend to, integrate, and retain the presented material. Cognitive slowing may constrain the older learners' ability to keep pace with the lecturer. The older learner may experience attentional deficits and fall further and further behind. Another contributing factor is that older learners may have been out of traditional classroom environments for many years. While this is beginning to change as the average age of the workforce increases, many older learners, particularly those over age 60, enter a traditional classroom experience with a critical lack of familiarity and comfort with the training protocol. Furthermore, due to decreased access to training, older learners often enter training with obsolete skill or knowledge sets[1] (Fossom, Arvey, Paradise & Robbins, 1986). These conditions have been associated with older learners' report of higher levels of both anxiety and overarousal (Hayslip & Kennelly, 1985; Sterns & Doverspike, 1987). These psychological states undermine older learners' training self-efficacy and reinforce their pre-existing tendency toward cautiousness (Birkhill & Schaie, 1975; Okun & DiVesta, 1976).

Still, the lecture method may prove useful under certain conditions: (1) if the older learner perceives the content as relevant, (2) the content builds on their current knowledge base, and (3) the information is presented in a logical sequence (Knowles, 1990; Tough, 1979). However, the primary benefit of the lecture method is efficient dissemination of information. Usually, but not always, this method is employed to convey a large amount of information to a large audience. When these conditions prevail, it is unlikely that the unique needs of older learners are addressed. Thus, we hypothesize:

H1a: The lecture method will not yield significant positive changes in older learner training performance.

Modeling

Behavioral modeling capitalizes on learners' ability to acquire knowledge by observing another person execute behaviors associated with performing a task (Bandura, 1986). Instructional videotapes often use behavioral modeling. It has been suggested that learners' confidence in their ability to perform a task increases with the use of modeling (Bandura, 1986). Confidence in one's ability to perform a task is an important factor in arousing the motivation to learn and has been identified as a particularly important consideration when training older learners (Knowles, 1990).

Research on training older learners suggests that they need to know why they must learn a task prior to the training experience or their motivation to learn may be compromised (Knowles, 1990). Viewing a model perform the focal task provides older learners with information regarding task-specific performance requirements and the outcomes associated with successful execution of the task. This information may enhance older learners' perceptions of the relevance of the training. Consistent with the literature, modeling has been

associated with training performance gains for older learners (Gist, Rosen & Schwoerer, 1988; Willis, Blieszner & Baltes, 1981; Willis & Nesselroade, 1990). However, the preponderance of research on modeling effects has been conducted on samples of younger adult learners and children. Furthermore, the research provides no evidence on the unique effects of modeling on training performance because modeling, in these studies, is used primarily in conjunction with other instructional methods (i.e., lecture and participating in the focal task). Nonetheless, the substantial body of literature supporting modeling effects leads us to hypothesize that:

H1b: The modeling method will yield significant and positive changes in older learner training performance.

Active Participation

Early research into training older learners began in Europe after WWII when England and Germany experienced severe shortages of younger male workers (Welford, 1976). Based on the assumption that traditional instructional methods do not work well for older adults, researchers sought an alternative. These researchers assumed that older learners were self-motivated and that for older learners physically passive learning was less effective than was physically active learning. They developed a method that required active participation in discovering how to perform the focal task (Belbin & Belbin, 1972). Often called the activity or the discovery method, active participation meant the trainee engaged in the learning process by actually performing the focal task. Unlike modeling, this involvement is not associated with watching another perform the focal task. Rather, the learner progresses through a series of steps uncovering for him or herself how to perform the task. This could include structured guidance or trial and error.

Researchers posit that active participation leads to self-discovery and holds learners responsible for their progress (Belbin & Belbin, 1968, 1972; Sterns & Doverspike, 1989). Research has shown that active participation enhances older learner training performance (Baltes, Sowarka & Kliegl, 1989; Belbin & Shimmin, 1964; Charness, Schumann & Boritz, 1992; Verhaeghen, Marcoen & Goossens, 1992).

Although active participation is generally operationalized with several instructional factors including self-pacing and the use of supplementary learning materials (e.g., outline, step-by-step guide), we hypothesize that allowing the older learner to uncover how the focal activity is performed, in and of itself, will promote learning. Specifically, we hypothesize that:

H1c: The active participation in discovering how a task is executed will yield significant and positive changes in older learner training performance.

Instructional Factors

Several instructional factors thought to improve older learner training performance have been identified. They are providing supplementary materials, slowing training pace, providing feedback, and reducing training group size (Belbin & Belbin, 1968, 1972;

Sterns & Doverspike, 1989). While widely accepted as beneficial to training older learners, we know of no research that systematically examines the contribution of each of these factors on older learner training performance. In this research, we examine these relationships.

Materials

Supplementary materials provide learners with printed information relevant to training task performance. Aging has been associated with deficits in attentional memory processes, particularly under conditions demanding divided attention. This may limit the amount of information older learners can register and therefore establishes an upper limit on information acquisition (Light, 1991). Supplementary materials, such as an outline of a lecture, or a reference guide, may serve as an external memory aid to help older learners address memory-related deficiencies (Twitchell, Cherry & Trott, 1996). Thus, written materials may be a rich resource to facilitate task mastery and enhance training performance among older learners.

Self-Pacing

One of the more robust findings in industrial gerontology is that physical and cognitive processes slow with age (Birren & Fisher, 1995). As a result, the time required to process training materials increases with age (Sterns & Doverspike, 1989). Research indicates that when given sufficient time, older learners can master training material (Meyer, 1987). There are a number of strategies for providing additional time (e.g., longer training sessions or multiple training sessions); however, learning theory suggests that self-pacing is the only option that fully accommodates the individual differences in learning that occur with aging (Kinsbourne & Berryhill, 1972). Self-pacing allows older learners to internalize the importance of the training and provides them ample time to complete the task and master the training content (Belbin & Belbin, 1968, 1972). Accordingly, self-pacing is hypothesized to promote training effectiveness for older learners.

Feedback

In a training context, feedback provides older learners with knowledge of their performance. Feedback may motivate older learners by increasing their sense of task mastery (Bandura, 1986; Sterns, 1986; Sterns & Miklos, 1995). Knowledge of training performance may also enhance older learners' sense of personal responsibility for training success. Some debate has emerged regarding the timing of feedback. The conventional perspective suggests that feedback should be immediate, accurate, frequent, and useful for modifying behavior (Schmidt & Bjork, 1992). Another perspective, however, suggests that faded or intermittent feedback yields superior long-term benefits (Schmidt, Lange & Young, 1990; Winstein & Schmidt, 1990). However, regardless of timing, researchers agree that feedback positively contributes to learners' training performance. Therefore, we hypothesize a positive relationship between providing feedback and older learner training performance.

Group Size

We identified only one study that examined training effects between individual and dyad training (Zardi & Charness, 1989). The results of this study along with several related factors suggest group size may be important to older learner training performance. Given older learners' predisposition toward caution, larger group size might diminish the likelihood they will interact with the instructor (Birkhill & Schaie, 1975; Okun & DiVesta, 1976). Smaller group settings would allow for more interaction between the trainer and the learner. Increased interaction with the instructor may also ease some of the negative emotional states reported by older learners, e.g., fear, anxiety, and overarousal. In this way, group size may affect older learner training performance. Although exploratory in nature, we expect to find a negative association between group size and older learner training performance.

In summary, four instructional factors—materials, self-pacing, feedback, and group size have been identified as potentially important aspects of training that may affect older learner training performance. Specifically, we hypothesize that:

H2a: Older learner training performance will be significantly and positively associated with feedback, materials, and self-pacing.

H2b: Older learner training performance will be significantly and negatively associated with group size.

The Present Study

The question driving this research is which instructional methods and instructional factors explain statistically significant variance in observed training performance of older adult learners. Using meta-analytic data integration, we assess the effects of three instructional methods and four instructional factors on observed older learner training performance. We examine both lab and field studies that employ a wide variety of instructional tasks ranging from computer use to memory enhancement techniques. This broad focus facilitates the inclusion of research on training and aging from multiple disciplines.

Method

Data

We identified relevant studies by a thorough search of journals and books. First, we identified studies through published literature reviews (e.g., Kubeck et al., 1996; Martocchio, 1989). Next, we used keyword combinations to query five computer-based indices covering the period from 1890 to the present day: two contained business administration literature citations, the others covered education, the sciences, and psychology literatures. Example keywords used were: train, training, training performance, training success, learn, learning, learner, worker with adult, age, aging, old, older, elderly. This phase of the search yielded

more than 300 abstracts. Next, we conducted an exhaustive manual search of key journals covering the period from 1950 to the present to assure that no relevant, published research was omitted from the analysis. Some of these journals included: *Personnel Psychology, Journal of Management, Journal of Applied Psychology, Academy of Management Journal, Psychology and Aging, Occupational Psychology, Journal of Technology and Aging, Journal of Gerontology*, and *Applied Cognitive Psychology*. This search yielded 14 additional articles. Finally, several prominent researchers in the fields of business and gerontology were contacted in an effort to obtain unpublished literature on the topic. This yielded five additional studies. In sum, we obtained 354 articles for potential use in this review.

The authors independently evaluated all 354 articles to assess their suitability for the present study using detailed coding sheets. Researchers recorded: pre-test and post-test measures[2] of observed training task performance; the use of the lecture method, active participation and modeling; study sample size; the type of dependent variable; the type of experimental task; the use of supplementary materials; provision of feedback; training pace (i.e., self-pacing or not), the number of participants in each training session; study setting (lab or field); and trainees' mean age. Interrater agreement reached over 90% on all items rated. In particular, we agreed 100% on all variables except pace of training and provision of feedback where the first author made the final categorization.

Excluded from the analysis first were those that did not examine empirically the relationships of interest. Substantial research on this topic is theoretical or based wholly on attitudinal data; this criterion resulted in the exclusion of many articles. Also excluded were studies that did not contain a pre-test–post-test design from which a training effect size could be obtained. When studies contained effect sizes across several measures of trainee performance, a weighted average correlation was used. For obvious reasons, articles using the same data set were not included (Hunter & Schmidt, 1990). When multiple studies used the same data set, we included the study with the largest sample size and excluded all others. Finally, despite an extensive search for file drawer studies, we identified only five. Of these, only two provided the requisite information for inclusion in our study. In sum, 41 studies reporting 51 effect size estimates ($n = 3613$) qualified for inclusion in our study. Twenty-four studies provided skills training, the remaining were more conceptual, e.g., memory training.[3]

Measures

Observed training performance. Observed training performance was measured as knowledge change via paper and pencil testing or skills change via skills testing. In nine of the lecture method studies, six of the modeling studies, and nine of the active participation studies training performance was measured as a skills test. The other studies for each method employed paper and pencil measurement of training performance. An analysis of the interaction between instructional methods (i.e., lecture, modeling, and active participation) and type of training performance observed (i.e., paper and pencil test vs. skills test) yielded no statistically significant result. Therefore, we conclude there is no confound of instructional method with type of training.

Training performance was computed from pre- and post-test performance scores on the dependent variable. Studies were included only when these data were reported. Correlations

between method and training performance were not presented in most studies. Where possible, these correlations were computed. Formulae necessary for transforming reported data into correlations by converting a *t*-test, exact *p*-values, differences between groups, or an *F*-value were found in Hunter and Schmidt (1990).

Operationalizations of instructional method and training effectiveness. All studies were coded for each construct. Specifically, measures were coded as follows: instructional methods were coded as used or not used where 0 = the method was not used and 1 = the method was used. Also coded were (a) the number of trainees per session, (b) time constraints (where 0 = time limited, 1 = self-paced), (c) provision of performance-related feedback (0 = no feedback, 1 = feedback), and (d) the use of supplementary training materials (0 = no materials, 1 = materials).

When coding for instructional method, we found that some studies used more than one method ($k = 12$). For example, Baltes, Dittman-Kohli and Kliegl (1986) used lecture and modeling while Hill, Allen and McWhorter (1991) used lecture and active participation. In these cases, the study was coded for both. Studies were coded for active participation when subjects were required to uncover how to perform the focal task. This could involve structured guidance or trial and error but subjects were required by the trainers to engage in the focal task to learn how the task is performed. Studies were coded for modeling when someone executed the focal task for the learner(s). Studies were coded for lecture when information was conveyed by presentation with the intent of imparting knowledge; merely reading the instructions or answering questions did not constitute a lecture.

Several control variables were also coded. In an attempt to include studies from a variety of disciplines, we identified studies that used a variety of different training tasks. We categorized training task type as directly work-related training (e.g., computer training) and not directly work-related (e.g., crystallized and fluid intelligence training).[4] Although the latter are not directly related to a specific work task *per se*, inductive reasoning, abstract reasoning and both short and long-term memory (types of fluid and crystallized intelligence, respectively) are important components of effective task performance on many jobs. Thus, we included studies that examined training performance on these important cognitive dimensions but coded for the difference. Type of task was coded (0 = not directly work-related, and 1 = directly work-related).

In addition, we coded for research setting (0 = field and 1 = laboratory) and mean age of the sample. Studies were selected because older learners were trained, yet, we found variance in the definition of "older learners." In most studies, the mean age of study participants was age 60 and older. Only one study fell below this level (Neale, Toye & Belbin, 1968). This variance led us to include a variable that would capture the diversity in age across studies; accordingly, we included the continuous variable, the mean age of trainees. The sample structure is reported in Table 1.

Analysis

Recent advances in statistical theory indicate that a random or mixed effects (RE) model better addresses the primary research question posed than does the fixed effects (FE) model traditionally used in applied psychology research (i.e., Erez, Bloom & Wells, 1996; Hox &

Table 1
Sample structure

Variable	k	n
Instructional methods		
Lecture	19	2695
Modeling	14	1465
Active participation	18	738
Instructional factors		
Materials	14	602
Self-pacing	17	438
Feedback	27	2439
Control variables		
Work-related tasks	13	365
Type of dependent variable		
Skill test	22	1490

Note: The sample size is $k = 51$ and $n = 3613$.

De Leeuw, 1994; Hunter & Schmidt, 1990). We seek to examine the influence of several moderators on observed training performance. Since researchers often use these methods and factors in conjunction with one another, a regression type model should be used. The RE meta-analysis combines summary statistics across the studies and allows for the comparison of effect sizes. This technique provides an estimate of the population effect size, the opportunity to determine whether effect sizes vary across studies, and if effect sizes do vary across studies, allows examination of the variation associated with each moderator variable. All moderator variables are coded and then entered as dummy variables; this allows analyses to examine the entire data set to model the effects of potential moderators. The result of the RE meta-analysis is an equation that can be interpreted similar to a traditional regression equation.

The RE model also presented several distinct methodological challenges. At the conceptual level, dependent variables may vary across studies. In our dataset, we examined learning as observed training performance. We found training performance was measured as both paper and pencil test performance ($k = 29$, $n = 2123$); and skill performance ($k = 22$, $n = 1490$). Despite noting approximately equal distribution of skills and paper and pencil tests across all three instructional methods and the absence of statistically significant interactions between the instructional methods and the type of dependent variable used, we decided to account for the conceptual differences by coding for type of dependent variable (paper and pencil test = 0 and skill test = 1).

Prior to conducting the data analyses, two transformations of the individual study effect sizes were performed. A fundamental assumption of maximum likelihood estimation procedures is that the data are drawn from an approximately normal distribution with a stable variance. Because summary statistics (e.g., raw correlations) are drawn from skewed distributions, we performed a Fisher's z transformation that normalized the distribution, stabilized the variance and provided an estimate of the within study variance $[1/(n-3)]$. A Hotelling's (1953) transformation was then conducted to further reduce any remaining bias in the z-transformed sample correlations. The probability density

function of the transformed correlation coefficients appears approximately normal for samples greater than 25 (Erez et al., 1996) and thus permitted application of maximum likelihood estimations.

The transformed correlations and the coded moderator variables are then used to conduct a two level hierarchical linear model analysis (Bryk & Raudenbush, 1992). The first level analysis estimates the average effect size. This analysis estimates between-study variance and provides a chi-square test of the null hypothesis that the between-study variance is zero. A nonsignificant result suggests there are no real differences between-studies and no reason to investigate moderator effects. Alternatively, if the between studies variance estimate differs significantly from zero, real differences are indicated and there is reason to model these differences.

We will first conduct a level-1 analysis where the fit of the unconditional model (without moderators) is assessed. While the purpose of this study is to examine the effects of instructional methods and instructional factors on older learner training performance, there would be no variance to explain with a level-2 model if training performance coefficients did not vary.

The conditional or level-2 analysis estimates the variance attributable to each moderator variable. Much like maximum likelihood estimations used in multiple regression, the level-2 analysis estimates the contribution of each predictor by controlling for the between-study variance attributable to the other predictors. To conduct this analysis, we enter dummy-coded data for the instructional method and instructional factor variables into the equation, and as in traditional regression analysis, the parameter estimates capture the differences in effects between groups that are coded 1 and the referent group coded 0. A significant indicator suggests that a specific instructional method or factor (e.g., lecture) has a relationship with training performance that is different from the relationship of the base group (i.e., no lecture). Similar to multiple regression analysis, the significance of a moderator variable is estimated as the percent of between-study variance explained. A significant finding suggests that the instructional method or instructional factor, independent of the other variables, contributes significantly in explaining variance in training performance.

Results

The transformed data were used to test the level-1 model. This analysis assessed the between-study variance associated with training performance. HLM was used to calculate an average effect size and evaluate whether the observed difference among studies was statistically different from zero. Results of this analysis revealed that the average correlation between method and observed training performance was $r = .30$. The test of the null hypothesis was significant ($\chi^2 = 109.61$, $p < .01$). Therefore, we rejected the null hypothesis that the between-study variance was zero and proceeded to examine the hypothesized moderator effects.

We tested our research hypotheses with a level-2 HLM model. We examined the combined effects of lecture, modeling, active participation, materials, self-pacing, feedback, age, setting, type of task, and type of dependent variable on observed training performance. This analysis included all study effect sizes ($k = 51$, $n = 3613$). The results of these analyses are summarized in the second column of Table 2. Note that Table 2 does not include

Table 2
Moderator analysis for older learners: final estimation of mixed effects

Unconditional model		Conditional model		
Variable	Coefficient	Coefficient	*T*-ratio	Percent of variance accounted for
Fixed effect				
Intercept	.29	−.65	−2.60**	
Instructional method				
Lecture		.14	2.03*	3.97
Modeling		.20	2.76**	9.99
Active participation		.19	2.00*	7.78
Instructional factors				
Self-pacing		.19	2.34*	14.94
Materials		−.08	−1.15	
Feedback		−.02	−.35	
Control variables				
Age		.01	3.33**	1.07
Type of task		.28	2.87**	.82
Research setting		−.15	−1.01	
Type of dependent variable		−.02	−.30	
Random effect				
σ^2	.01941	.00901		
Deviance	189.65	255.67		

Note: 51 effect sizes were used in all analyses reported. The sample size of the 51 effect sizes was 3613.

results for the effect of group size. Not all studies reported training group size. Thus, a separate analysis was conducted using only studies that reported this moderator ($k = 16$, $n = 1720$).

For the conditional model (excluding group size), the chi-square statistic revealed that the estimated residual variance associated with the model was significant ($\chi^2 = 64.43$, $p < .01$). The results reveal that of the hypothesized moderator variables, lecture, modeling, active participation, and self-pacing were significantly related to observed older learner training performance. The subanalysis for group size also emerged as significant. In addition, two control variable emerged as significant: average age of trainees and type of task.

These results provided partial support of our hypotheses. Specifically, H1a proposed that the lecture method would not significantly improve the training performance of older learners. The data failed to support this hypothesis. A positive and statistically significant association emerged between use of the lecture method and observed training performance ($t = 2.03$, $p < .05$). This relationship accounted for 3.97% of the total between studies' variance. Modeling also had a significant association with training performance ($t = 2.76$, $p < .05$), accounting for 9.99% of the total between studies variance. Thus the results supported H1b. The results also supported H1c. We found a significant positive contribution for active participation in predicting training performance ($t = 2.00$, $p < .05$); this association accounted for 7.78% of the variance.

H2a proposed that supplementary materials, self-pacing and feedback would each positively influence training performance of older learners. This hypothesis was only partially supported. A statistically significant relationship was only associated with self-pacing ($t = 2.34$, $p < .05$). Self-pacing accounted for 14.94% of the total between studies variance. We found support for H2b that proposed a negative relationship between group size and training performance. The effect of group size on training performance was evaluated using a subset of the data ($k = 16$, $n = 1720$). This conditional model analysis revealed a significant negative association between group size and the training performance of older learners ($t = -2.50$, $p < .05$). Finally, two control variables emerged as significant: mean age of the trainee group ($t = 3.33$, $p < .01$) and type of task ($t = 2.87$, $p < .01$), accounting for 1.07 and .82% of the total between studies variance, respectively.

In sum, the results revealed statistically significant differences in the observed training performance of older adult learners for each instructional method. Training that occurred in smaller groups or training that enabled learners to progress at their own pace was associated with higher levels of observed training performance relative to training occurred in large groups or training that was paced. Finally, two control variables, mean age of the training group and the use of performance-related tasks (for instance, word processing performance), also explained significant, but much smaller portions of the observed variance in training performance.

Discussion

In their discussion of directions for training research, Tannenbaum and Yukl (1992) call for greater attention to the effectiveness of training programs for particular groups. In this research we examine the effects of various instructional methods and instructional factors on older learner training performance. The results of past research clearly show that older individuals can and do learn; our results provide additional support for this notion as we found a significant training effect for older learner training performance.

Many disciplines have explored topics related to training and aging; however, this is the first empirical review of the effects of instructional methods and instructional factors on older trainee performance. We found statistically significant associations between lecture, modeling and active participation and observed training performance. Furthermore, by employing a RE approach we are able to determine that each method contributes independently of the other methods to explain observed training performance. Thus, training that integrates multiple methods could be useful when training older learners.

In many respects, this finding is consistent with research on the activity training method. The activity method advocates active participation in discovering how to perform the focal task. Proponents of this method also call for the use of a number of other instructional factors (e.g., use of materials, feedback, self-pacing). In essence, the activity method can be viewed as active participation in discovery of how to perform the task coupled with a collection of instructional factors (Belbin & Belbin, 1972). We found that a statistically significant association between the unique andragogical contribution of the activity method, active participation in uncovering how to perform the focal task, and observed training performance.

We also found significant contributions associated with both the lecture method and modeling. However, we found that only one instructional factor, self-pacing, significantly contributes to the explanation of older learner training performance. Thus, although activity advocates integrating many instructional factors to promote learning among older trainees, our results suggest that the focus may be better placed on integrating multiple methods rather than using multiple instructional factors.

Many dismiss the lecture method as an instructional method for training older learners (Glass, 1994). The assumption has been that older trainees lack familiarity with the training content because they have attended little or no training for a number of years. It has been argued that cognitive slowing that occurs with aging would limit the older learner's ability to keep up with the presentation, particularly when the content is novel (Belbin & Belbin, 1972; Knowles, 1990; Sterns & Doverspike, 1989). Combined, these factors were hypothesized to limit the effectiveness of the lecture method for promoting retention of information among older learners. However, we know of no other study that has expressly examined the effects of the lecture method on older learner training performance. Our findings indicated that the independent effects of lecture are statistically significant. Thus, if the assumption that older adult learners have been out of traditional classroom settings for an extended period of time were true, the absence did not result in sufficient unfamiliarity with the method to render it ineffective. Another possible explanation might be appropriate selection of instructional method. There may be situations where one method may be more effective than another. For example, the lecture method may be more appropriate to introduce corporate policies whereas active participation may be more appropriate for computer training. Alternatively, the result could reflect appropriate application of the method. However, a *post hoc* analysis of the interactions between instructional methods and type of training failed to attain statistical significance, thus, among the studies included in this manuscript, we found no data to support the latter assertion.[5]

The other instructional method under investigation is modeling. By offering learners the opportunity to watch another successfully perform the focal task, modeling has been shown to improve training performance (Bandura, 1986). However, few studies have examined the effects of modeling on older adult learner training performance; most studies examining modeling effects have used children or younger samples. Yet consistent with theory and prior research, we found a statistically significant association between modeling and older learner training performance. Our data suggest that the positive effect of modeling on training performance generalizes to the special case of the older learner.

Modeling is hypothesized to be most effective when the learner identifies with the model. Although we have no data on the degree of identification between the model and the learners, it poses an interesting research question. To date, few studies have examined the effectiveness of modeling for training older learners. Although our analysis indicates modeling is associated with higher older adult performance, we wonder whether increasing similarities between the model and the learner could strengthen this relationship. Social cognitive theory would support this perspective. However, the data on perceptions of age and perceptions of self-age identification suggests the opposite. People tend to hold quite negative general perceptions of aging; these perceptions have been identified even in samples of older people. Older people tend to report feeling younger than their age, engaging in activities that are not typical of their age group, and identifying with younger people. Evidently, many

older adults view themselves as exceptions to the negative stereotypes associated with aging. Given these perceptions, one could hypothesize that older people may identify with models significantly younger than their chronological age, but this is an empirical question that warrants serious attention. Given the importance of training older learners now and for decades to come, future research should investigate this issue.

Regarding instructional factors, we found support for the importance of self-pacing and group size. The largest statistically significant relationship emerged between self-pacing and observed training performance. This finding is consistent with the aging and cognition literature that reports the most robust finding in the aging literature is physical and cognitive declines associated with aging (Birren & Fisher, 1995). The use of self-pacing provides older learners with ample time to assume responsibility for their learning, and to focus on the task, understanding its importance and developing comprehension of how it is performed. These are essential elements of andragogy (Knowles, 1990). Thus, although andragogy has its detractors, based on the results of this research it does appear to be a useful framework for understanding older adult learning (Hayslip & Kennelly, 1985).

As with all research, this research has limitations. First, age is not a manipulated variable. Furthermore, much of the research on aging is cross-sectional in nature. These factors do not permit empirical analysis of the difference between aging, period and cohort effects (Palmore, 1978). Second, meta-analyses are constrained by the limitations of the original studies. Fortunately, by combining a large number of effect sizes over a large population we increase our confidence in the findings. Third, 12 of the effect sizes reported in our meta-analysis included more than one instructional method. The information provided in the original research limited our ability to determine the extent to which each method was used. Fourth, our sample contained only four unpublished studies. This represents only a small percentage of our total sample. Past research, however, has revealed no statistically significant differences in effect sizes found in published vs. unpublished studies (Gaugler, Rosenthal, Thorntoer & Bentson, 1987; Glass, McGaw & Smith, 1981; Hunter & Schmidt, 1990; Rosenthal, 1984). Furthermore, the results of our *post hoc* file drawer analysis revealed that more than 105 file drawer studies with nonsignificant method-training relationships would have to be identified to nullify the significant effects found in our sample of studies (Rosenthal, 1984). Our investigation focuses solely on older learners, the data emphasized samples age 60 and older. By including only learners over age 40, we are unable to determine whether these results hold for younger adult learners. However, interaction analysis conducted between age and method revealed no statistically significant result.[6]

Nevertheless, our results offer important insights into training older learners. Training older learners will continue to challenge practitioners and researchers for decades. As the work force ages, technology advances, and processes change there will be an ever-increasing need to train older learners. We find that multiple instructional methods facilitate learning among this group; however, self paced training makes the largest positive impact on training performance among older learners.

Notes

1. Obsolescence does not occur on all knowledge, skill, and ability sets. Experts are often able to maintain high levels of competence in their content area. In this relatively new

area, researchers are investigating how older subjects who are content area experts maintain or expand knowledge bases.

2. In a few cases, when multiple sessions were employed, the first session was used as a proxy for a pre-test measure. This is a conservative adjustment and was applied to only four studies.
3. For a complete list of studies included in the analyses, contact the first author.
4. Crystallized intelligence represents learned concepts, relationships, data, or general information. For example, crystallized intelligence could assess one's understanding of numbers, and how to perform basic mathematical functions, e.g., addition, subtraction. Fluid intelligence represents the application of known relationships, concepts, data, or general information in a novel way. For example, interpretation of data or arranging information in a novel way would be classified as fluid intelligence.
5. Thank you to an anonymous reviewer for raising this point and encouraging investigation of the issue.
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